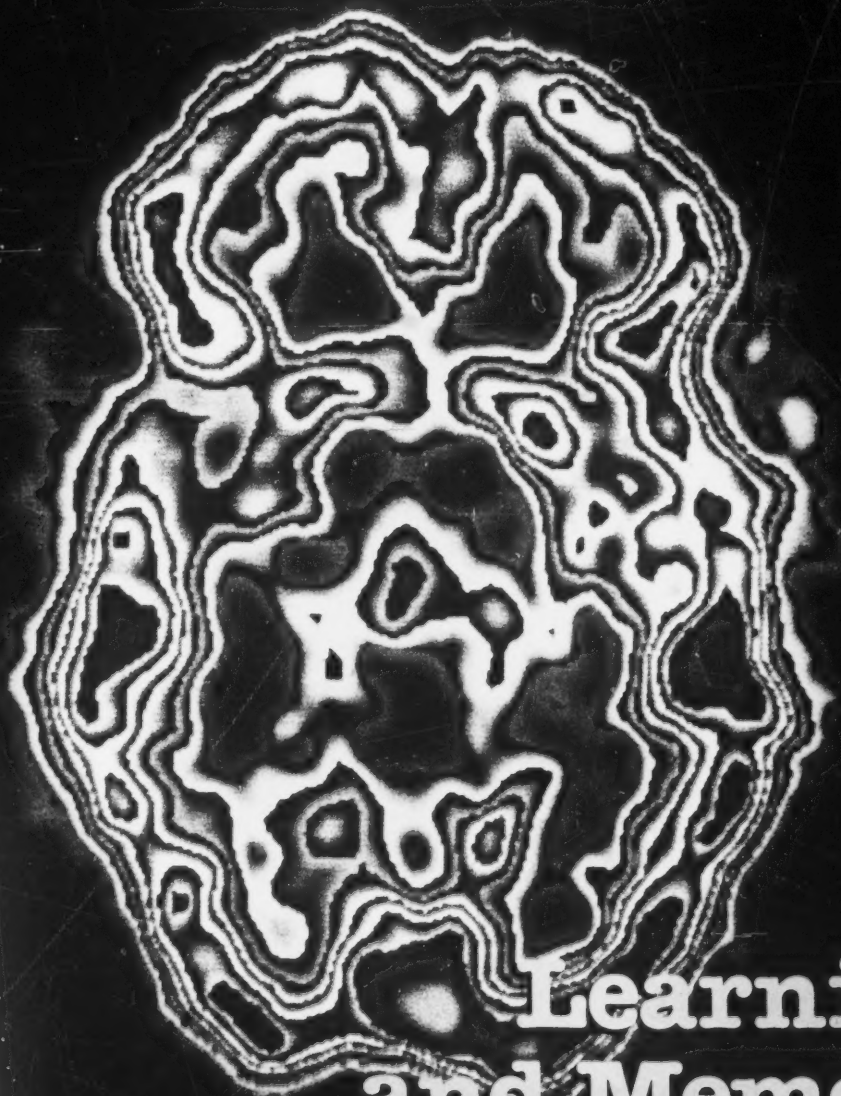
OCTOBER 7, 1991

CHEMICAL & ENGINEERING

NEWS



Learning and Memory

Chemistry joins other sciences to unravel molecular bases of these processes

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CHEMICAL & ENGINEERING
NEWS
Volume 69, Number 40
CENEAR 69 (40) 1–72
ISSN 0009-2347
OCTOBER 7, 1991

News of the Week

■ **Indian Supreme Court hands down decision on Bhopal disaster that upholds 1989 $470 million settlement, but opens Union Carbide to criminal charges.** **Page 4**

■ **Government Accounting Office report says federal agencies are not adequately regulating environmental chemicals that cause harmful reproductive effects.** **Page 5**

■ **Science and math achievement among U.S. elementary and secondary students increased slightly in 1980s but not enough, in some cases, to match early 1970s' scores.** **Page 5**

■ **EPA announces measures to cut costs and expedite Superfund cleanups.** **Page 6**

■ **Atmospheric scientists launch six-month mission to study ozone depletion in Arctic regions.** **Page 6**

Cover: Positron emission tomography scan of human brain. Photo courtesy of E. S. Garnett et al., Chedoke-McMaster Hospitals, Hamilton, Ontario, Canada

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Business

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Government

Universities found to spend federal direct R&D dollars carefully, according to recent report; proposed new ethics regulations for federal workers draw fire from scientific community. **Page 15**

Science/Technology

Sonochemistry shown useful for controlling chemical reactions, creating unusual materials; oligonucleotide binding to duplex DNA to form triplex DNA is flexible interaction; U.S.-made device for measuring global total ozone—sent aloft in Soviet spacecraft—is working well; membrane technology workshop for undergraduate faculty draws engineering educators from across the nation; NAS plans revamp of U.S.-foreign scientist exchange programs. **Page 18**

ACS News

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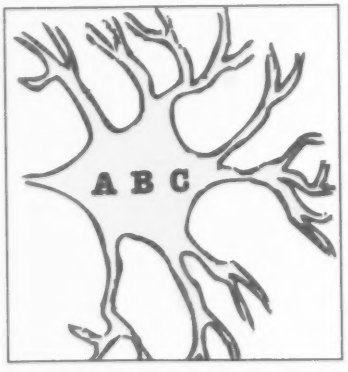
Awards

ACS award winners: Allcock, Bartlett, Barton, Basolo, Brookhart, Browne, Bryant, Bunnett, Carpino, and Chang. **Page 46**



Special Report

Chemistry joins a host of sciences in task of solving the molecular bases of learning and memory and of identifying the regions of the brain in which these processes take place. **Page 24**

Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036
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Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-4432
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Subscription Rates 1991: Printed editions: nonmembers U.S. 1 yr. $95, 2 yr. $171; outside U.S. 1 yr. $131, 2 yr. $243. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $12. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C. and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

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LETTERS

CHEMICAL SAFETY

Reactivity of perfluorocarbons

In a letter on chemical safety (C&EN, June 10, page 2), a group of Dow chemists alerted readers to the reactivity of perfluorocarbons toward oxidizers. In response to this letter, the vice president of Halocarbon Products countered (C&EN, Aug. 5, page 2) that saturated perfluorocarbons and chloroperfluorocarbons do not ignite in the presence of 2000 psig of oxygen gas even at 400 °C. He, therefore, concluded that before any recommendations in the safety letter on perfluorinated organic compounds are implemented, more information is needed.

In view of these conflicting letters I would like to call attention to two pertinent unpublished studies from our laboratories. In the first study, laboratory tests were carried out to duplicate the failure of an oxygen tank containing Teflon components during the *Apollo 13* mission in 1970. The conclusions reached at that time were:

- The combustion of Teflon in oxygen to give carbonyl fluoride is highly exothermic; for example, 148 kcal per mole. However, a powerful ignition source is required owing to the high activation energy of the reaction. The minimum ignition temperature is 465 °C, even under 7500 psi of oxygen gas.
- The ignition of Teflon tubing at −61 °C in supercritical oxygen at 900 psi O_2 pressure required a hot nickel-chromium wire as an initiator. The main combustion products were CO_2, CF_4, and COF_2.

In the second study on solid propellant NF_3–F_2 gas generators, it was found that mixtures of Teflon powder and NF_4^+ salts burn smoothly when initiated by conventional solid propellant ignitors. As in the case of oxygen, strong fluorooxidizers can react with Teflon in highly exothermic reactions to yield CF_4.

In conclusion, both of the previous letters raise valid points; namely, that fluorocarbons or Teflon, $(CF_2)_n$, are only half oxidized and are capable of undergoing highly exothermic combustion reactions with either oxo- or fluorooxidizers, and that the activation energies for these reactions are so high that under normal operating conditions it is very difficult to initiate these combustion reactions.

Karl O. Christe
Rocketdyne Division
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Canoga Park, Calif.

Licensing of chemists

The letter to the editor, "A real profession" (C&EN, Aug. 19, page 5), suggests that misuse of technology was responsible for the incidents at Bhopal and Chernobyl, the Ford Pinto fires, and the *Challenger* explosion, and proposes licensing of chemists as a means of enforcing their competence and ethics.

During many years of association with working chemists, both in academia and industry, [I have found that] they have been almost universally both capable in their areas of activity and of the highest ethics. The fact that recently reported incidents of unethical behavior are newsworthy suggests its rarity. Less glowing statements can be made about those who manage the activities of chemists. The pressures imposed upon chemists by the institutions they work for to publish more extensively, cut costs more deeply, and get to the marketplace more quickly are enormous. Ultimately, chemists are compelled to cut corners, and tragedy may result.

Corrections

- Sept. 16, page 2: In the letter on chemical safety, the estimated equilibrium partial pressure of hydrogen should be 5.0×10^{6} atm, not 2.22×10^{3}.
- Sept. 23, page 3: In the letter on unnecessary journals, the impact of ever-more journals and ever-increasing subscription prices has been profound and disruptive for university libraries, not industry libraries.

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Biotechnology industry posts record revenues

Product sales for the biotechnology industry reached a record high of $4 billion for the fiscal year ending June 30. This 38% increase over the previous year was driven by Food & Drug Administration approval of 11 biopharmaceutical products, according to San Francisco-based professional services firm Ernst & Young's annual report on the biotechnology industry, "Biotech '92: Promise to Reality." Also, although the industry is dominated by health care companies, the first genetically engineered biopesticides, produced by Mycogen, received Environmental Protection Agency approval.

"The product trickle of previous years has turned into an outright flow," says Kenneth B. Lee, national director for life sciences industry services at Ernst & Young. "Almost as many products as were approved in total in years prior were approved this year."

The promise of the future was always exciting, explains G. Steven Burrill, Ernst & Young's national director of high-technology industry services, but biotechnology companies now are being evaluated by more traditional measures of success. Instead of hedging bets solely on promising R&D, intellectual property rights, and potential products, companies are being valued by benchmarks such as product sales, market size and penetration, stages of product development, and strategic alliances for commercialization. As a result, industry executives running established companies are changing their priorities and being "less entrepreneurial."

"It's an industry driven by very real products and very real companies," adds Burrill. "We are about to see Amgen as a leading company make its way into the Fortune 500—that would be [a] first for this industry." Amgen received FDA approval to market erythropoietin (EPO) in June 1989 and its second biopharmaceutical product, granulocyte colony-stimulating factor, this year. Sales of EPO by Amgen and its licensees could surpass $500 million in the near future. "There are only a handful of billion-dollar products in the pharmaceutical industry, so for any one of these [biotechnology firms] to have a billion-dollar product moves it into the big leagues instantly."

Other major biotechnology products include Genentech's tissue plasminogen activator, γ-interferon, and human growth hormone; along with human insulin, α-interferon, and granulocyte macrophage colony-stimulating factor developed by firms such as Biogen and Immunex. Another 17 products are awaiting FDA approval and more than 100 biopharmaceuticals are in various stages of clinical trials. Comments Lee, "There is still a tremendous amount of upside opportunity for biotechnology. The products usually come with substantial individual sales opportunity—$50 million to $100 million in annual sales."

However, most of the 1100 companies in the industry are small and need continued financing to fund R&D. "The uncertainty around the Persian Gulf War and economic news of the time tended to cause investment capital to move toward the health care industry," says Burrill. "And when the investors were looking for exciting stories, they looked much beyond the traditional drug companies and realized that [biotechnology] companies were bringing exciting new products to the market."

The success of companies such as Amgen, Genentech, Immunex, Biogen, Chiron, Genzyme, and Centocor attracted the attention of investors to the industry as a whole. Biotechnology has been in the midst of its biggest financing year ever, raising over $2 billion in the first six months of 1991. A record number of initial and secondary stock offerings among the 194 public companies has increased the overall industry market capitalization by 75%, to a record $35 billion.

"I think we can expect that as the sales flow continues to increase that the [stock] market will react favorably," Burrill adds. "But I think it is also fair to say that when one looks at the market, it will continue to be both volatile and event-driven." Patent issuances, court decisions regarding patent rights, regulatory issues such as product approvals or delays, and significant financings or strategic alliances are events that play a major role in the stock market valuation of individual companies and the industry as a whole.

In addition, as more companies move out of research into product development, explains Lee, the need for capital to build commercial infrastructure will increase substantially. A net loss of nearly $3 billion, 45% higher than the previous year, was reported for the industry. Strategic alliances with major companies, still numerous but down in number because of available capital from public markets, are expected to continue to be important.

Large, established biotechnology companies now have the ability to set up intra-industry alliances or make acquisitions. And, the number of startup companies has dropped with decreasing venture capital investment. With about 40 mergers and acquisitions in the past year, including those involving older, major companies such as Genentech, Cetus, Genex, and Genetics Institute, a net consolidation of the biotechnology industry may be on the horizon.

Ann Thayer

Industry balance sheet shows growth

	Public companies			Industry total		
	1990–91	1989–90	% change	1990–91	1989–90	% change
Product sales ($ billions)	$ 2.86	$ 2.26	26%	$ 4.0	$ 2.9	38%
Revenues ($ billions)	$ 3.78	$ 3.08	23	$ 5.8	$ 4.7	23
Net loss ($ billions)	$ −0.81	$ −0.44	84	$ −2.9	$ −2.0	45
No. of companies	194	180	8	1,100	1,100	0
No. of employees	33,000	29,000	14	70,000	66,000	6

Note: Fiscal years ending in June. **Source:** Ernst & Young

Henkel-Ecolab new force in cleaning market

In one sweep of the pen, the professional cleaning and hygiene business in Europe obtained a new market leader—a joint venture called Henkel-Ecolab, formed by Germany's Henkel and St. Paul, Minn.-based Ecolab Inc. Agreed to in July but officially launched late last month, the new company has projected annual sales of about $800 million this year, more than European sales of Anglo-Dutch producer Unilever, and of Diversey, owned by the Canadian brewing company Molson.

The Henkel-Ecolab venture was formed when Ecolab integrated its European business into the venture with Henkel, the largest shareholder in the Minnesota company, earlier this year. Henkel, in turn, split off its industrial and institutional operations from its larger businesses in detergents and chemicals to contribute to the venture. Ecolab continues to sell its products everywhere in the world except Europe. The resulting company, based in Düsseldorf, has some 3500 employees throughout Europe.

Not only is the new venture the European leader, but it also is in serious contention for market leadership worldwide, even though its sales are solely in Europe, says Ehrhart Schlüter, managing director of the new venture. Henkel-Ecolab's sales will be only slightly smaller than those of parent Ecolab, long the worldwide market leader, which now has about 8% of the market, and of Diversey, which through acquisitions this year has pulled up to that level, as well.

Those three companies, and Unilever, lead a worldwide industry mostly made up of hundreds of small- to medium-size local or regional companies. Worldwide sales of industrial and institutional cleaning and sanitation products are nearly $12 billion, of which Europe will account for $4.7 billion this year.

The long- to medium-term outlook is for growth of at least 10% per year, predicts Schlüter. Even the short-term outlook is good, at least for Henkel-Ecolab: Its sales in 1992 are expected to grow at least 10% over 1991, he adds.

Both Henkel and Ecolab are major companies in their respective markets. Ecolab, whose sales topped $1 billion in 1987, has long been the world's largest supplier of industrial cleaning and sanitation products. Henkel's sales in that area topped 1 billion deutsche marks in 1988—about $570 million—second only to Unilever in Western Europe.

The venture's research and development and service activities will be supported throughout Europe by Henkel's research center in Düsseldorf and by Ecolab's in St. Paul. The venture also will be able to tap into the laboratories of both parents for such specialist work as microbiological, ecological, and toxicological testing, and for packaging systems and process development.

More than 60% of the venture's production will come from its own plants, with additional output from Henkel's plants in Europe. The new company has set up three business units: GV, to focus on cleaning and sanitation for institutions, hospitals, and commercial laundries, among others; P3-F, to target the food and agricultural industries, and the pharmaceutical and cosmetics industries; and Ecolab, to provide cleaning products and dishwasher detergents for commercial kitchens such as at hotels and restaurants, caterers, and office cafeterias.

With the combination of Henkel's and Ecolab's plants and sales offices scattered across Europe, the joint venture will have a presence in some 17 countries, stretching from Turkey in the east to Norway in Scandinavia. Plants are in Ireland, the U.K., France, Belgium, the Netherlands, Germany, Switzerland, Italy, and Denmark. And the company already has established sales offices in Poland, Czechoslovakia, Hungary, and Yugoslavia.

The three Henkel-Ecolab units roughly cover the spread of the traditional industrial and institutional market. Suppliers to this market serve segments such as textiles cleaning for hospitals and commercial laundries; hard-surface cleaning in industrial and institutional plants, offices, and other locations; restaurants and hospital hygiene; and cleaners and disinfectants for the food and agricultural industries.

Suppliers have grown up in the general vicinity of where they are needed—supplying bottle-washing detergents for the local brewery, for example. More and more, however, the industry is taking on an international look. An international brewer, say, might wish to rely on transnational suppliers able to meet international safety, product, and environmental standards. Companies in the business also increasingly supply not just chemicals, but dispensing and control systems, as well as the appropriate training courses for customers' personnel.

All these developments are part of what Henkel-Ecolab sees as part of the industry's revised thinking on the relationship of what is offered and what is actually needed. Not only are internationally comparable products one of the major requirements, the company argues, but so also is the capability for international service and consultation.

Those requirements, in turn, are driving the need for size among suppliers. In response, there has been a consolidation of companies. The trend has been going on for a number of years but has accelerated recently. For example, earlier this year, Diversey—which formerly had about 5% of the worldwide market—took a major step forward with the acquisition of Chemed's DuBois Chemicals subsidiary, boosting its market share to about 8%.

Patricia Layman

Voluntary Retirements Obscure Employment Picture for Chemists

What is a termination? What about the case of a veteran employee who accepts "voluntary" early retirement, but does so because of fear that turning it down could soon be followed by involuntary dismissal on less favorable terms? What about early retirement or resignation that occurs because the only alternative is transfer to a less desirable job or location?

These are some of the questions that are of increasing concern to ACS's Committee on Professional Relations (CPR) as it strives to maintain the accuracy and fairness of its long-standing program of investigating and reporting on mass terminations of chemists.

The committee defines a mass termination as a situation in which the employment of three or more chemical professionals is terminated within a three-month period for reasons other than properly documented inadequate performance, completion of a contract, or cause. Implicit in this definition has always been the involuntary nature of the terminations.

In its latest termination report, the 32nd in a series dating back to 1974, CPR points to the increasing use of early retirement incentive programs. The committee predicts this trend likely will continue as the "baby boom" generation ages.

The report also points out that the committee's conservative stance of counting only terminations that are unambiguously involuntary could be causing it to understate weaknesses in the current employment situation for chemists—especially older ones.

Another concern of CPR is the relative dearth of information from terminees themselves. The committee bases its reports on data supplied by both terminees and employers. Employers usually respond when asked. But normally CPR will approach an employer only after it has received data on a termination from at least three individuals involved. This is not always easy to do. Hence, some mass terminations may not be fully investigated and not reported.

At one time, committee members thought terminees might be reluctant to provide data to ACS because of secrecy clauses in their termination agreements. However, returns of a modified questionnaire used by the committee for the first time last year indicate this likely is not the case.

CPR reported only three completed termination investigations in each of its two previous reports. These were the smallest reports ever. The average for all 32 reports is a little more than eight. The latest report covers a still relatively modest five cases, involving about 50 chemical professionals.

However, CPR believes it is premature to speculate that such terminations are being phased down. The committee points out it has another 15 as yet unverified mass terminations under investigation. These involve a total of about 250 chemists.

The five terminations covered in the latest report occurred between May 1988 and December 1990. The largest, involving 17 chemists, was at Engelhard. The smallest, involving five chemists, at Kendall. The others were at Upjohn, PQ Corp., and Mead Imaging.

As with previous reports, CPR compared the performance of the

Employer compliance with ACS employment guidelines

These employers provided information	Approximate number of employees separated	Advance notice	Severance pay	Assistance	Employee service	Protection plans
Engelhard Corp. (Edison, N.J.)	17				▨	▨
Kendall Co. (Boston, Mass.)	5					
Mead Imaging (Miamisburg, Ohio)	6		▨		▨	▨
PQ Corp. (Conshohocken, Pa.)	10					
Upjohn (North Haven, Conn.)	11					

☐ Employer met or exceeded guideline standard.

▨ Two or more individuals below guideline standard, but average experience better than "substantially below" criterion.

☐ Employer was substantially below guideline standard, which is defined as follows:

- Advance notice—less than four weeks.
- Severance pay—less than two weeks per year of service.
- Assistance—no assistance rendered.
- Employee service—more than 30% of terminees had 10 or more years of service.
- Protection plans—no continuation of protection plans.

employers involved with termination standards contained in ACS's Professional Employment Guidelines (PEG). Overall compliance was 52%. This compares with an average of 41% for the about 260 terminations covered in all 32 reports. The guidelines cover the involvement of long-service employees, severance pay, assistance in obtaining new employment, extension of protection plans, and advance notice.

PEG states that chemists with a minimum of 10 years' service should not be terminated except for inadequate performance or cause. However, such long-term employees lost their jobs in all five terminations investigated in the latest report, as they did in all but five, or 8%, of the 65 mass terminations investigated by CPR in its last 10 reports dating back to 1986. For the earlier 22 reports, compliance was at a higher 29%.

Compliance with the PEG guideline for severance pay, two weeks for each year of service, is also low. But in this case, it is gradually improving. In the latest report, three of the five employers met it. Since 1986 40% of employers have met this standard. Before that, compliance was only 17%.

ACS guidelines

Advance notice. Four-week minimum.

Severance pay. Minimum is two weeks per year of service. Additional notice may be given, by mutual agreement, in lieu of severance pay.

Assistance. Efforts should be made to place terminee in another position within the organization, or terminee should be given assistance to find employment elsewhere.

Employee service. Those with minimum of 10 years' service should not be terminated except for continued evidence of previously documented inadequate performance or cause.

Employee protection plans. Should be extended for a minimum of one month, plus two weeks for each year of employee service, following termination, at same rate of contribution as before. Employee would have additional 31-day grace period.

The highest compliance is with the standard concerning assistance to terminees in finding new employment. All five firms met it in the latest report. For the past six years it has been met by 85% of employers.

Compliance for the remaining two guidelines falls into a middle range—50% for the extension of health protection plans for a reasonable time after termination, and 40% for a minimum of four weeks of advance notice.

Copies of termination reports as well as of related C&EN articles are available on request from the Office of Professional Services, American Chemical Society, 1155—16th St., N.W., Washington, D.C. 20036.

Michael Heylin

Academic Professional Guidelines approved

The American Chemical Society has put into effect a set of Academic Professional Guidelines that outline some of the obligations and reasonable expectations for individuals in the academic employment environment. The guidelines were recently approved by the ACS Board of Directors at its meeting in New York, following adoption earlier this year in Atlanta by the ACS Council.

Developed by the council's Committee on Professional Relations (CPR), the guidelines specifically address professional relationships among academic faculty, graduate students, and postdoctoral fellows. According to Ramon A. Mount, CPR chairman, the guidelines do not attempt to be comprehensive. Rather, he says, they address some specific situations that the committee believes to be of special concern.

The new academic guidelines are similar in purpose but otherwise separate from the ACS Professional Employment Guidelines (PEG), developed more than 20 years ago by CPR to address industrial employee-employer relationships.

After receiving requests some years ago for guidelines in addition to PEG that addressed academic professional relationships, CPR set up a task force in 1988, chaired by Grace B. Borowitz of Ramapo College of New Jersey, to develop such a set of guidelines. The task force submitted draft guidelines to the council for comment as well as to more than 100 graduate chemistry departments. Responses and comments have been incorporated into the current version just approved.

The ACS Office of Professional Services says it intends to publish the guidelines and distribute them to academic institutions across the nation. Like PEG, the academic guidelines probably will be updated periodically. Following is the entire text of the guidelines as approved by the council and board.

ACS Academic Professional Guidelines

April 1991

Preamble: The Academic Professional Guidelines are intended to provide key guidelines for graduate students, postdoctoral associates, professors, mentors, and academic administrators concerning professional relationships in the academic environment. These guidelines outline some of the obligations and reasonable expectations for individuals as they interact in the unique academic employment environment.

It should be noted that a graduate student or postdoctoral in chemistry generally meets the ACS definition of a chemist and a professional. The term "professor" is employed as a generic term referring to all ranks in the academic research and teaching hierarchy. For brevity, the expression "chemist" or "student" is employed in these guidelines to encompass biochemists, chemical engineers, and others in chemical-related sciences who meet the ACS definition of a chemist.

A. The graduate student and postdoctoral associate—obligations to the professor and to the university.

1. The graduate student or postdoctoral associate should fulfill the responsibilities required by a teaching or research position.

2. The student or postdoctoral associate should maintain honesty, integrity, and diligence in the conduct